NORSK NAVAL ARCHITECTURE.

By GEORGE H. BOEHMER.

(With five plates.)

In the section of Naval Architecture in the United States National Museum at Washington there is on exhibition the model of a boat used in the fisheries at Söndmöre, Norway, and with slight modifications all along the coast of Norway, from Egersund, in Lister, round the North Cape to the frontier of Russia, a distance of about twelve hundred geographical miles. They are called "Nordlandsbaade" (Northland boats), are described as long, narrow, and low, light and elegant, and fit both for sailing and rowing,[1] and are believed by the fishermen of that region, on account of their peculiar construction, to be more elastic, safer, and swifter in a sea way.

THE SÖNDMÖRE BOAT.

(See Plate xv.)

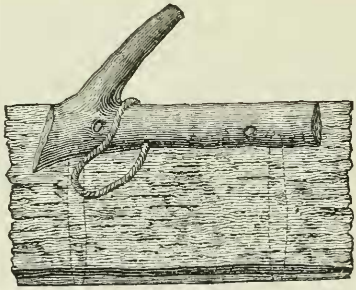
This boat is described as being clinker-built, and having four strakes, except at the bow, where there are six strakes; lower bow-plank put on diagonally with end chamfered to fit on other planks, to which they are nailed; no gunwales; strengthening pieces along the inside next to upper strake; heavy timbers; boat entirely open; six thwarts; five rowlocks; deep keel, curving up like a sled-runner at each end to form stem and stern posts, which are high; bottom slightly concave, with much dead rise, being nearly straight to top of upper strake; ends sharp and very flaring; small rudder; peculiar-jointed tiller; single mast, stepped amidships, with strong rake; four shrouds aside, with toggles on lower ends that pass through beckets at the boat's side; single lugsail, with narrow head, tacks down to stem.

The rowlocks of all the Northland boats, from the most ancient to the present Norwegian fishing craft, exhibit the same general model, although they differ from one another in size and details of work. In every case they are cut out of one piece of timber. The representation given on next page is from a boat built at Rannefjord, in the "Nordlands Amt," about latitude 66 north.

They are called "Keiper," and the same term ("Keipr") is found in old Icelandic sagas (Fornmanna Sögur) and in the Snorre's Edda. The Keiper consists of a piece of wood fastened to the gunwale by wooden pegs—in the Söndmöre boat, in the absence of a gunwale, they are

[1] Diriks and E. Sundt, in "Folkevennen" of 1863 and 1865.

fastened to the top plank by two iron nails—bearing an oblique prolongation at one end, and furnished with a loop of wicker-work rope or leather, through which the oar is passed, and which prevents its slipping out of the keip while rowing. These rowlocks are in Norway considered superior to ordinary tholes, being not so liable to break as the latter.



In some fishing craft the planks are tied to the frames by ropes through holes in the under side of the frames and corresponding holes or in cleats projecting from the planks.

Little, if any, change appears to have been made in northern naval architecture, for in the Northland boats of the present day we recognize the oldest forms known to us from the rock sculptures (*Helleristninger*, or *Hällristningar*) discovered in Sweden and Norway, with an antiquity reaching far back into prehistoric times, and supposed to have originated from 500 to 800 years before the Christian era; from boat-shaped stone burial groups (*Skibssætninger*, or *Stenskepper*) supposed to have been erected during the transition time from the bronze period to the iron age in Scandinavia, and from *Boat remains* found at various times and places, representing structures dating from the third to about the ninth or tenth century of the Christian era.

I.—HELLERISTNINGER,[1]

or hällristningar, the picture groups of Scandinavia, engraved upon rock and originated during the bronze age, represent in simple outline

[1] O. Rygh: Om Helleristninger i Norge. I Videnskabs Selskabet i Kristiania Forhandlinger, 1873, p. 455–470. Dr. Henry Peterson: Notice sur les Pierres Sculptées du Danemark; in: Mémoires de la Société Royale des Antiquaires des Nord; Copenhague, 1877, p. 330–342. (Cited by Dr. C. Rau: Cup-shaped and other Lapidarian Sculptures, p. 25, in—Contributions to North American Ethnology, vol. v; U. S. Geographical and Geological Survey of the Rocky Mountain Region; U. S. Department of Interior.)

more or less equipped ships, sharp at the ends, with stem and stern posts alike, both curved and high. The oars appear as a series of vertical strokes along the sides of the ship.

Such representations have been discovered: in Denmark,[1] on the capstone of a funeral chamber near Herrestrup; in the northwest of Seeland;[2] on a bronze knife excavated in Ditmarsch;[3] in Sweden, on a heavy diorite slab from a tumulus in Scania, called Willfarahög;[4] at Kivik, Christianstad Län, Scania;[5] in Bohuslän,[6] on the Häggeby stone in Upland and on runic stones upon Gotland. The accompanying illustration (see Plate xvi) shows a runic stone found in Alskog parish, at Tjängvide, in the southern part of the island of Gotland. It is now in the museum at Stockholm. At the base is a dragon-ship with only one mast and one sail. (The illustration was taken from Paul du Chaillu, The Land of the Midnight Sun: New York, 1882.) They occur in Norway, along the coast as far north as Throndhjem fjord;[7] and in Russia, upon the southeast bank of Onega Lake,[8] which is the only one known to exist within the east Baltic regions of Russia.

Of the construction of the boats represented in these sculptures of course nothing is known, nor do the engravings permit of any estimate as to their dimensions, the only record handed down to us being the outlines, which, however, are sufficient to serve in the comparison with the lines of later structures.

A different view of the outlines of boats, supposed to have belonged to the period at the beginning of the Christian era, and which, in form,

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[1] Worsaae: The Primeval Antiquities of Denmark; translated by W. J. Thomas; London, 1849, p. 91. (Cited by Rau: Cup-shaped and other Lapidarian Sculptures, p. 27.) Worsaae: Nordiske Oldsager i det kongelige Museum i Kjöbenhavn, fig. 171–175. (Cited by C. Rau: Cup-shaped and other Lapidarian Sculptures, p. 27.)

[2] C. Rau: Cup-shaped and other Lapidarian Sculptures, p. 27, and fig. 21. Simpson: Archaic Sculptures, &c., p. 72. (Cited by Rau, &c., p. 27.) Ferguson: Rude Stone Monuments, fig. 106, p. 303. (Cited by Rau, p. 27.) Peterson, Dr. Henry: Notice sur les Pierres Sculptées du Danemark, p. 338. (Cited by Rau, p. 27.)

[3] Kemble: Horæ Ferales, p. 228.

[4] Nilsson: Das Bronzealter; Nachtrag, p. 42. (Cited by Rau, p. 29.) Simpson: Archaic Sculptures, &c., p. 78. (Cited by Rau, p. 29.)

[5] Rau: Cup-shaped and other Lapidarian Sculptures, p. 30 and figs. 24. Nilsson: Das Bronzealter. (Cited by C. Rau, p. 30.) Peterson: Notices sur les Pierres Sculptées, &c. (Cited by Rau, p. 30.)

[6] Montelius: Bohuslänske hällristningar, Stockholm, 1876, pp. 3, 18. Rau: Cup-shaped and other Lapidarian Sculptures, p. 30 and fig. 25. Nilsson: &c., p. 90. (Cited by Rau, p. 30.) Holmberg, A. E.: Scandinaviens Hällristningar, Stockholm, 1848. Åberg, Dr. Lennart: Hällristningar uti Bohuslän; in: Annaler for Nordisk Oldkyndighed; Kjöbenhavn, 1839; plate x, p. 386.

[7] N. Nicolaysen: Langskibet fra Gokstad ved Sandefjord. Kristiania, 1882, p. 9.

[8] Archiv für Anthropologie, x, p. 86; wood-cut, fig. 4. Grewingk, C.: Ueber die in Granit geritzten Bildergruppen am Onegasee. In: Bulletin histor. philol. de l'Académie des Sciences de St.-Pétersbourg, xii, No. 7 et 8. Schwede: Nachr. Iswestija der geographischen Gesellschaft zu St. Petersburg, 1850, p. 68. Grewingk, C.: Verhandlungen der esthnischen Gesellschaft zu Dorpat, vii, Heft 1, p. 25.

again resemble the Northland fishing boats of the present day, is obtained from the so-called

II.—SKIBSSÆTNINGER,[1]

(Stenskeppar, Skeppshögar, Skeppsformer;[2] Schiffsetzungen; Wella-Laiwe, Teufelsboote, or Steinschiffe)[3] or rows of stones set in such a manner as to form the outlines of boats, and which were employed for sepulchral purposes by the Vikings.

Sweden is the center of distribution of Norske boat-shaped groups. They occur in Bohuslän, Schonen, Blekingen, Oeland, Gotland, Nericke, and Upland.[4] Similar structures have been found near Stralsund, Germany,[5] and in the Baltic provinces of Courland,[6] and Estnish Livonia[7] of Russia [8]

In Courland, Russia, only seven of these positions have been discovered, all being located in the diocese of Erwahlen,[9] and with one exception they occur in pairs, situated behind each other. The outlines of long, narrow, and pointed vessels are represented by a single row of stones. The stem and stern posts are shown by large bowlders, thus indicating for these parts a considerable elevation above the bulwark

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[1] C. Engelhardt: Denmark in the Early Iron Age, London, 1866, pp. 38, 39.

[2] Bidrag til Kännedom om Göteborgs och Bohusläns Fornminnen.

[3] C. Grewingk: Die Steinschiffe von Musching und die Wella-Laiwe oder Teufelsboote von Kurland überhaupt. Dorpat, 1878. Döring, J.: Die Teufelsbootevon Kurland. Sitzungsberichte der Gesellschaft für Literatur und Kunst, 1860–1863. Mitau, 1864. Berg, C.: Notiz im Correspondenzblatt der Naturfor. Gesellsch. zu Riga, xx, 1872.

[4] Archiv für Anthropologie, x, pp. 83, 84.

[5] Hagenow: In Baltische Studien der Ges. f. Pommersche Geschichte, xv, 2, p. 49. Archiv für Anthropologie, x, p. 82.

[6] Grewingk: Zur Anthropologie des Balticums und Russlands. Im Archiv für Anthropologie, x, pp. 73–100; 297–300. Grewingk, C.: Die Steinschiffe von Musching und die Wella-Laiwe oder Teufels-boote von Kurland. Grewingk, C.: Steinalter der Ostseeprovinzen. Dorpat, 1865, p. 45. Döring, J.: Im Sitzungsbericht der Gesellsch. f. Literatur und Kunst. Mitau, 1864, p. 154. Berg: Im Correspondenzblatt des Naturforschenden Vereins zu Riga, xx, 1872, No. 7. Burchardt: In: Baltische Monatsschrift, xxiv. Riga, 1875.

[7] Sievers, Graf C.: Verhandlungen der estn. Gesellschaft zu Dorpat, viii, Heft 3, 1876. Sievers, Graf C.: Verhandlungen der Berliner Gesellschaft für Anthropologie, October 1875. Sitzungsberichte der estn. Gesellschaft. May, November, December, 1876. Archiv für Anthropologie, x, p. 79.

[8] Sitzungsberichte der Gesellschaft für Geschichte der Ostseeprovinzen, 1875, Riga, 1876, p. 54.

[9] Grewingk, C.; Die Steinschiffe von Musching und die Wella-Laiwe oder Teufelsboote Kurlands überhaupt. Dorpat, 1878. Zur Archaeologie des Balticums und Russlands. Im Archiv für Anthropologie, x, p. 73. Döring: In: Sitzungsberichte der Ges. f. Literatur und Kunst. Mitau, 1864, p. 154. Grewingk: Steinalter der Ostseeprovinzen, Dorpat, 1865, p. 45. Berg: In Correspondenzblatt des Naturfor. Vereins zu Riga, xx, 1872, No. 7. Burchardt: In: Baltische Monatsschrift, xxiv, Riga, 1875. Archiv für Anthropologie, x, p. 75.

of the boats; excavations in the bord-stones indicate the rowlocks. Their outlines are reproductions of the Upland, Häggeby, and Gotland runic stones. The direction of the boats suggests in the construction a general southeasterly course.

At a depth of from six inches to a foot below the surface a large stone plate was found, serving as a cover to chests built of plates of either natural or artificial formation. The cells of these chests were occupied by urns composed of gravel mixed with clay but little burnt, and containing more or less cremated human remains. The following illustration (see Plate xvii), copied from "C. Grewingk, Die Steinschiffe von Musching und die Wella-Laiwe oder Teufelsboote Kurlands überhaupt," shows in *a* the arrangement and outlines of these boat-positions; in *b*, a sectional view of one of the Musching boats, and in *c*, the stone chests which have served for the reception of the cremated remains of the dead.

Similar boats have been found in Livonia. Among them is the Slaweek stone boat[1] from the shores of Little Strante Lake in the district of Walk. It has a double row of bord-stones, from 4 to 5 feet high, is supplied with thirteen or fourteen row-benches, and is rounded off at stem and stern. The cremated remains of the dead had been deposited on the level ground between the stones.

In Estnish Livonia[2] similar positions were found, but lying either singly or in fours they are indicated by single rows of stones in a northeast to southwest or east to west direction, and are rounded off at stem and stern. They exhibit as many as eleven row-benches and some large bowlders, possibly indicating the position of the mast.

The boat representation found near Stralsund, Germany,[3] was provided with a double row of bord-stones. In its interior space, obliterated by digging, an empty chest of thin stone plates was found.

Among the boat representations of Sweden those in the forest of Braidfloar on the Island of Gotland,[4] of Eds in Upland,[4] Blomsholm in Bohuslän,[4] Kåseberg,[5] Lungersås upon Gotland,[5] Raftötangen in Blekingen[5] are the most important.

The dimensions of all these boat representations vary greatly; they may, however, be divided into two general groups of which the one includes only the seven positions of Courland, while all the other boats are included in the second group.

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[1] Sievers, Graf C.: Verhandlungen d. estn. Ges. zu Dorpat, viii, Heft 3, Dorpat 1876. Sievers, Graf C.: Verhandlungen der Berliner Gesellschaft für Anthropologie, 1875, October.

[2] Archiv für Anthropologie, x, p. 80. Sitzungsberichte der gelehrten estnischen Gesellschaft zu Dorpat, May, November, December, 1876; January, 1878.

[3] Hagenow, in Baltische Studien der Gesellschaft für Pommersche Geschichte, xv, 2 p. 49. Archiv für Anthropologie, x, p. 82.

[4] Archiv für Anthropologie, x, p. 83.

[5] *Ibid.*, p. 84.

Dimensions of boat positions.

Positions.	Length.	Width.
	Feet.	*Feet.*
Erwahlen, I position, Musching, 1	31	8
2	27	13
II position, Lieben, 1	25	10
2	31	10
III position, Widser, 1	50. 9	14
2	49. 0	10
IV position, Nogallen, 1	47. 10	10
Slaweek boat, Russia	140	40
Estnish Livonia, Russia	From 50 to 100	About 25
Stralsund, Germany	130	16
Braidfloar, Gotland, Sweden	144	16
Upland, Sweden	182	50
Blomsholm, Bohuslän, Sweden	141	31½
Kåseberg, Sweden	212	60

III.—Boat remains.

Although the form of the earliest Northern boats has thus become known to us, the mode of their construction, whether covered with wood or skins, tied together with withes or sinews, may forever remain a secret. Our first knowledge in this respect is of post-Christian boats belonging possibly to the third century after Christ; and this knowledge was derived from the discovery and excavation, at various times and places, of the remains. Such discoveries were made at Ultuna,[1] Lackalänga,[2] Borre[3] (near Horten, Norway), at Snape,[4] Suffolk, England (at which place a boat was dug out, 40 feet 8 inches long, 9 feet 6 inches wide, and 3 feet 10 inches deep, clinker built, containing, among other articles, a glass vessel with projections of a shape similar to one found in the boat discovered at Borre, and being well known from graves of the latter part of the iron age in England, France, and Germany).[5] Similar finds were made in the parish of Tune, and at Gokstad, Norway,[6] Nydam Moss, Schleswig, Prussia,[7] and other places.[8]

[1] B. E. Hildebrand, in Report of the seventh meeting of Scandinavian Naturalists, Kristiania, 1856, appendix, p. 644.

[2] N. G. Bruzelius, in Annaler for Nordisk Oldkyndighed, 1858, p. 179.

[3] Nicolaysen, in the report for 1852 of the Society for the Preservation of Norwegian Antiquities.

[4] Davidson, in the Proceedings of the Society of Antiquaries, London, 2d ser., vol. ii–iv.

[5] C. Roach: Smith's Coll. Ant., vol. ii, pl. li. Cochet, Normandie Souterraine, pl. x.

[6] Nicolaysen, N.: The Viking Ship discovered at Gokstad, in Norway, with a map, 10 engravings, and 13 plates. 88 pp., 4°. Kristiania, Alb. Cammermeyer. Langskibet fra Gokstad ved Sandefjord. Beskrevet af N. Nicolaysen. Med 1 kort, 10 træsnit, og 13 plancher. Kristiania, 1882.

[7] C. Engelhardt: Denmark in the Early Iron Age. London, 1866, p. 29. Sir John Lubbock: Prehistoric Times. Second edition. London, 1869, p. 8. Prof. Georg Stephens, F. S. A.: "Nydam Moss," in "The Gentleman's Magazine," October, 1863, new series, vol. 15, p. 681.

[8] N. Fornlevn., pp. 20, 179, 245, 551. (Cfr. N. Nicolaysen, Langskibet, &c., p. 12). Aarsber. f. Foren. t. Norske Fortidsmindesm. Bevar , 1869, 94; 1879, 292; 1880, 45. (Cfr. Nicolaysen, Langskibet, &c., p. 12.) O. Rygh: Faste fornlevn., og oldsag., i Nordre og Söndre Throndhjems Amt, p. 24, i. (Cfr. Nicolaysen, Langskibet, &c., p. 12.) Skilling-Magazin, 1867, pp. 717–719, 724, 738–739. (Cfr. N. Nicolaysen, Langskibet, &c., p. 12.) Polytekn. Tidsskrift for 1867. (Cfr. N. Nicolaysen, Langskibet, &c., p. 12.)

The vessels excavated from the mound raised over them had served as a burial place, in conformity with the Viking custom known to have prevailed among the Northmen throughout the later centuries of paganism in Scandinavia.

This mode of burial has been of great importance to archæological research, since it enabled us to study, from the remains thus preserved in a more or less perfect state and brought to light by excavation, the naval architecture of the nations among whom such customs prevailed.

The vessels excavated vary considerably in size, ranging from mere boats of 20 feet in length to sea-going vessels with a length of keel measuring from 40 to 60 feet. In the majority of cases the vessels had been placed on an even keel and the remains of the dead deposited with such articles as were to accompany the departed, after which a mound of earth was thrown up over the grave.

The composition of the earth used in the construction of the mound, together with other influences, had often tended to destroy the wooden structure, and often only just enough has been found to determine the size of the boat and its position in the mound. In many cases, too, the wood-work had been burned with the corpse, so that no positive knowledge could be obtained of the form or of the dimensions of the sepulchral ship.

The oldest naval relic of the early Scandinavian iron age ever discovered, part of an oar, was found in the Nydam Moss, northeast of Flensburg, in the Duchy of Schleswig, in the year 1859, and the remaining part of the same oar in 1862. On August 7, 1863, the remains of a boat were excavated; on October 18, 1863, a large and magnificent oak-built boat was discovered, lying in the direction of the valley, from southeast to northwest, and on October 29, 1863, a third boat, built of fir, was found at the side of the second boat and parallel with it.

The first of these boats was in a very poor state of preservation, having ing evidently been intentionally destroyed; nevertheless the fragments found and taken up displayed sufficient resemblance to the corresponding parts of the second and third boats to indicate the same construction for all the three boats. The second, and best preserved boat, was placed in the hands of Mr. Stephenson, restorer of antiquities, of Copenhagen, and of the restored boat the accompanying drawing (see Plate xviii) is a representation as figured by Prof. C. Engelhard[1], under whose direction the excavation of Nydam Moss had been placed by the Danish Government.

From its close resemblance both to the ancient form as represented in the "Helleristninger" and to the modern Northland boat, as illustrated by a model of a Söndmöre (Norway) boat in the United States National Museum (previously figured and described), the description as given by Professor Engelhard might be of interest, and I am indebted

[1] C. Engelhard: Denmark in the Early Iron Age. London, 1866.

to Dr. Charles Rau, of the U. S. National Museum, for the loan (probably the only copy in Washington) of the work for this purpose.

"When first discovered the boat, of course, was no longer in its original state. In course of time the washers of the bolts by which the planks were fastened together had corroded; the ropes joining the outer parts of the boat to the inner frame-work had been destroyed; the planks, in consequence, had separated and reassumed their original shape; the rowlocks had fallen from the gunwale; the ribs had sunk out of their proper places, and lay in different directions, while the stem and stern-posts had detached themselves from the bottom plank. By degrees, as the boat fell to pieces, these sank to the bottom to about the same depth, whilst the peat, at the same time, grew up around them, covering and protecting them from destruction. The shape of the boat could not, therefore, be directly ascertained from the pieces found, and the sketch was made after it had been restored to its original form in the Museum of Northern Antiquities at Flensburg.[1] No drawing, however, can fully convey the striking impression produced by the large, sharp, and well-built boat itself.

"The boat is 77 feet long, measured from stem to stern, and proportionally rather broad in the middle, viz, 10 feet 10 inches at the bottom, but higher and sharper at each end; it consists of eleven oak planks, five on either side, besides the bottom plank, of which the keel forms part, the latter being only a little more than 1 inch deep and fully 8 inches broad at the middle of the boat, gradually diminishing and at last disappearing entirely towards the stern posts.

"On all the planks there are perforated clamps of one and the same piece with the planks themselves, having been left projecting when the planks were cut out of the solid timber—a most surprising fact, considering the high development to which the smith's art had been carried by the people of the early iron period; a fact, too, which proves that they must have possessed a great abundance of timber, as they would not otherwise have wasted it to that degree, only in order to save a few nails, or to secure the clamps so much better.

"The boat is clinker-built, the planks held together by large iron nails, at intervals of $5\frac{1}{2}$ inches,[2] with large rounded heads outside and square burs or washers inside. The spaces between the planks where they overlap each other were filled up—caulked—with woolen stuff and pitchy, sticky substance. The planks are cut from very fine pieces of timber, the bottom plank being 46 feet 8 inches long, and all of one piece. On both sterns, which are fixed to the bottom plank by means of wooden pegs, there are ornamental grooves, and each of them shows two large holes, which, to judge from the marks of wear, most likely

[1] The restored boat is now in the Museum at Kiel, Prussia.*

[2] In the boat found at Snape, Suffolk, England, seven nails occupy a space of 3 feet, which corresponds with the Nydam boat as stated by Engelhard.

have served to pass the ropes through when the boat was to be hauled ashore. The ribs, which give the boat its shape, are mostly in their natural crooked and irregularly bent shape, and rest on the clamps projecting from the planks, which form regular rows across the boat, those on one plank corresponding exactly to those on the next. The ribs have perforations corresponding to the clamps, through which bast ropes were passed, tying planks and ribs together. This is again a fact highly surprising in a nation familiar with the use of iron, and able to work it so well, as their damascened swords prove that they could. At the same time it is possible that a loose connection between the frame-work and the planking of the boat served to give more elasticity to the sides, and that the boats built in this manner went through the surf and great waves easier than those more strongly built.

"On the gunwale were fixed the rowlocks, which, although made on the same general model, yet all differed from one another in size and in the details of the work. They were tied to the gunwale by means of bast ropes, and in this case, too, it might seem surprising that for fixing such important pieces as the rowlocks recourse should have been had to such weak fastenings, which must so often have required to be renewed.

"But this method had at the same time the advantage of rendering it possible to turn them, when necessary, and row the boat in the opposite direction, particularly as both ends of the boat are so exactly alike that it is difficult to say which is the prow and which is the stern. It is true that the width of the boat at the fourth rib is a few inches greater than at the fifteenth rib, which corresponds to it at the other side; but this difference is so small that it was probably not intentional, and the boat has no doubt been designed to shoot through the waves with equal speed, whichever way it was rowed. Its shape, therefore, in some respects, reminds us of Tacitus' description of the ships of Suiones[1]. For their ships differed entirely from those of the Romans, particularly in this, that the stems were exactly alike, so that, whichever way they were rowed, they had a prow fit for resisting a collision or for landing; and, besides, the ships of the Suiones had no sails. Tacitus further says of these boats, that their oars were not fixed in a row along the sides, but were loose, as in certain craft used on rivers, and could be put into the water on either side, as might be required; but this part of the description would not apply to the boats found at Nydam, for on them the oars were passed through loops of rope tied to the rowlocks, on which the marks of wear by the oars are still quite visible; they could not be turned the other way without loss of time and labor, nor would it be possible to back the oars for any length of time, or with sufficient precision, when they are thus tied to the rowlocks.

[1] Germanica C., 44.

"At the side, about 10 feet distant from the stern, the rudder was discovered.[1] Its length is 9 feet 7 inches, and near the middle it has a hole, through which a rope may have been passed for the purpose of tying it to the side of the boat. Just below this hole there is a little cushion of wood fixed with three wooden pegs, intended to protect the rudder from injury by knocking or grating against the side of the boat, and at the top end there is a loose piece with two handles.

"This is the most ancient form of rudder known. Rudders quite similar to this in shape and construction may be seen on many representations of ships of classic times, and always on the right-hand ["starboard"] of the steersman. Lateral rudders were retained down to a rather late period, and are represented, for instance, on the Bayeux tapestry of the middle of the XI century; in the bas-relief over the door of the Leaning Tower at Pisa, built in the XII century, &c.

"This kind of rudder must have been in use even after the middle of the XIII century, for in contracts concerning ships to be built for Louis XI the builders promise to furnish them with two rudders. It was only at the close of the XIII century that the side rudder was supplanted by the hinged rudder now in use.[2]

"The thwarts were strengthened by two angular boards underneath, and supported by three perpendicular pieces of wood. Only in one place, by the middle thwart, these boards were tolerably well preserved, but even there the ends were so soft as not to admit of any very complete examination, and it remains uncertain in what way they were fixed to the sides of the boat. A wicker-work mat covered the bottom of the boat. * * * The fir boat was tolerably complete when first discovered, and its different parts were brought on shore during the next following day after it had been laid bare and the contents taken out, on the 27th of October, 1863. In order to protect the timber of this boat until the restoration of the oak boat was finished it was covered over with peat, but before anything could be done to save it the country was occupied by hostile armies, in the spring of 1864. * * * Since then parts of it have been carried away, and the last remnant will probably soon be destroyed and disappear.

"* * * The bottom plank was about 51 feet 4 inches long, and ended in two points, which probably have carried long and pointed iron spurs; if so, these spurs must have been under water. The side planks have clamps ornamented with moldings, and cut out of the same piece of timber as the planks, just as in the two oak boats. The shape of the rowlocks is somewhat different, and they have formed a continuous row along the gunwale.

[1] It will be observed in the representations of the Nydam boat that the positions of rudder and rowlocks do not correspond; in fact, that the rudder is located near the stem. It is, however, conjectured that this apparent misrepresentation is intentional to better illustrate the methods of fastening.

[2] A. Jal, Archéologie Navale, passim; Smith's Voyage and Shipwreck of St. Paul.

"In this boat, as in the oak boat, the planking was tied to the ribs by ropes passing through the holes in the clamps, and the principle of construction was the same; the great peculiarity of the fir boat being the terminal prolongations of the bottom plank, which probably have carried iron points—a dangerous weapon of attack, equally fit for sinking an enemy's vessel or holding it firm while being boarded.

"As in the oak boat, the bottom was covered by a mat of wickerwork. In several places the timber had cracked, and been repaired by patches of wood. On their inner surface there are vestiges of the caulking material, consisting of woolen woven stuff, and a pitchy kind of substance similar to that used for fixing the feathers on the arrows.

"The boats here described I consider to have been merely rowing-boats, not destined to carry sails, and in forming this opinion I rely principally on the fact that neither masts nor any signs of rigging has been discovered, nor any arrangement in the boats for fixing the necessary ropes. It is true that in the middle of the bottom plank of the oak boat, as well as of the fir boat, there is a hole of about 1½ inches diameter; but these holes are too small to have carried masts, and may have served for letting out water when the boats were hauled on shore, as was probably the case at the beginning of the winter.

"* * * As I have stated before, the oak boat had been intentionally sunk by means of large holes cut in one of its sides below water-mark; at the same time it had been caused to lean over on that side which was nearest the shore, that is, on the northeastern side. Besides this, the stem-posts had in course of time detached themselves from the bottom plank, leaving a large opening at each end. All these circumstances had necessarily caused a great part of the contents of the boat to float or drift out of it. But a part remained, and showed, in several respects, an intentional arrangement, objects of the same kind being accumulated into heaps at particular places.

"*. * * In Nydam, Roman denarii were discovered, embracing the period from 69 to 217 of our era, and of the following emperors and empresses: Vitellius (1), Hadrian (1), Antoninus Pius (10), Faustina the Elder (4), Marcus Aurelius (7), Faustina the Younger (1), Lucius Verus (2), Lucilla (2), Commodus (5), and Macrinus (1). The latest of these coins was minted in A. D. 217.[1]

"They give us an approximate date for the objects with which they were found. Allowing some time for their transport from southern countries, the deposit in our peat bogs cannot have taken place before about the middle of the third century.

"All the known coins from discoveries of this age—from mosses, graves, and chance finds—are of the first three centuries of the Christian era;

[1]Obs: Laureate head. Imp[erator] C[aius] M[arcus] Opel[ius] Se[verus] Macrinus Avg[ustus]. Rev: Pont[ifex] Max[imns] Tr[ibunitia] P[otestate] Co[n]s[ul] P[ater] P[atriæ]. Jupiter standing, a spear in his left hand, and the thunderbolt in his right.

the latest known is of Macrinus (A. D. 217). Among them, coins of the Antonines are of most frequent occurrence."

Two representatives of Viking naval architecture, dating from the period extending from the year 800 to 1050 after Christ, are preserved in the Archæological Museum of the Royal Frederiks University at Christiania, Norway, and in these we again observe the same beautiful and graceful lines exhibited both in the Norwegian fishing-boats of the present day and in the rude drawings and other representations of boats previously described. One of these boats, the

TUNE SHIP,

was excavated from a mound in the parish of Tune, Norway, between the Christiania fjord and the Swedish frontier. In conformity with the Viking customs, it had served as a burial place, and although much of the wood had become decayed, and in addition to this, the sepulchre had previously been disturbed, it afforded much information, as an actual relic, of the character of the vessels belonging to the Viking period. The management of the excavation was intrusted to the skillful hands of Mr. O. Rygh.[1]

Commodore H. Müller, of the Norwegian navy, in his book,[2] revised by the historian, Prof. P. N. Munch, states "that the long-ships, in the peculiar sense of the word, must have been ordinarily clinker-built," and this statement is confirmed in the Tune ship, which is built entirely of oak, and is composed of keel, stem and stern posts, frames, timbers, beams, knees, and planking.

The keel, with a length of 45½ feet, is fixed to the stem and stern posts; the width of the boat amidships is 14½ feet.

The frames, 13 in number, are united by cross-beams, and are not fixed to the keel, but lie free above it. On the top of the frames, fitted on to the overlying limbs of the knees and their continuations, rest the ends of the beams, thus forming a ledge for the ends of the bottom boards to rest in. The knees are attached to the beams.

The planks, 12 in height, are laid in the same manner as in our present yachts and boats, each upper plank projecting a little over the edge of the lower one. Only the bottom plank and the two top planks were fastened with iron nails, the former to the keel, the latter to the knees; all the intervening ones, though fastened to each other by bolts of iron, riveted together, having been tied to the frames by bast ropes through holes in the underside of the frames and corresponding holes or in cleats projecting from the planks. The thickness of the planking differs, being in the lower ones almost that of the two top planks. The tightening of the joints was effected by means of a thin layer of oakum made of cow's hair.

[1] Skillings Magazin, 1867, p. 717-719, 724, 738-739. (cfr. Nicolaysen, Langskibet etc., p. 12.) Polytekn. Tidsskrift, for 1867. (cfr. Nicolaysen, Langskibet, p. 12.)

[2] Søkrigshistoriens vigtigste Begivenheder, p. 1. (cfr. Nicolaysen, Langskibet, etc., p. 14.)

The rudder had a fixed position somewhat before the stern-post on the right side of the vessel. The helm consisted of a plank in the shape of a broad oar, the lower portion of which, in the middle, was provided with a round hole, through which it was fastened to the side of the boat by means of a rope, while its short round upper neck was caught by a grummet. A small aperture in the opposite direction of the blade was made for the tiller in the upper part of the neck. The rudder was mounted with iron,[1] to which one or more cramps were added down towards the heel of the rudder.

The mast[2] is set in an opening made in a large block of oak fixed above the mid-frames of the vessel; over this is a large grooved block to admit the beams. The aperture extended at the same breadth a considerable distance sternward in order to facilitate the raising and lowering. In the fore it is supported against a projecting knot of the wood, so that there is a space between the mast and the side of the slot in the mast-block.

The most recent excavation of Viking naval architecture,

THE GOKSTAD SHIP,

(See Plate xix.)

was made in 1880, by Mr. Nicolaysen, president of the Norwegian Archæological Society, at Gokstad, near the town of Sandefjord, west of the mouth of the Kristiania fjord, and a short distance from the head of a small frith. This ship, fully described by Mr. Nicolaysen,[3] as well as that from Tune, belongs to the Archæological Museum of the Royal Frederiks University at Kristiania, and of the same I now give the description, verbatim, as obtained while viewing these interesting relics on occasion of a recent visit to Norway.

The ship measures 67 feet along the keel and 79 feet 4 inches from bow to stern (extreme measure); the width amidships is 17 feet; and its depth amidships, from keel to top of bulwark, 4 feet.

The ship is entirely of oak, clinker-built, the boards connected with iron nails and the seams caulked with oakum made of cow's hair spun into three-stranded cord. The connection of the plank with the frames is effected in the same peculiar manner as in the Tune ship. In the top sides only have nail fastenings been used, part of wood and part of iron; elsewhere the plank and frames are tied together through holes in the under side of the latter and corresponding holes in cleats which project from the planking. The cleats and the plank are in one piece In this vessel the plank is fastened to the frames with ties made of the

[1] Bergens Bylov, ix, p. 18. (cfr. Nicolaysen, Langskibet, p. 19.)

[2] Skillings Magazin, 1867, p. 717. (cfr. Nicolaysen, Langskibet, p. 20.)

[3] The Viking ship, discovered at Gokstad, in Norway. With a map, 10 engravings, and 13 plates; 88 p., 4°. Kristiania, Alb. Cammermeyer, 1882. Langskibet fra Gokstad ved Sandefjörd. Beskrevet af N. Nicolaysen. Med 1 Kort 10 Træsnit og 13 Plancher. Kristiania, Alb. Cammermeyer, 1882.

tough roots of trees. Such mode of fastening was possibly adopted to counteract the injurious effect of expansion and contraction in the wood when alternately wet and dry.

The planking has an average thickness of about 1 inch. The scantling, however, is not uniform throughout; thus the tenth strake from the keel is almost twice as thick, but somewhat narrower, and the fourteenth from the keel, that in which holes are cut for the oars, about $1\frac{1}{4}$ inch thick.

This ship, as indeed was the case with even the largest vessels of the Viking period, had both oars and canvas to propel her, and there has been only one mast. The mast was frequently lowered; for instance, when rowing against a head wind or when preparing for battle. The peculiar arrangement of ponderous beams at the step of the mast serves to facilitate raising and lowering; it affords, too, an excellent support, which, with the extreme lightness of the ship's scantlings could hardly in any other manner have been given to the mast. This method of fixing the mast is exactly similar to that adopted in the Tune ship; nay, the ornamental form given to the top beam, which has the ends modeled so as to represent the tail of a fish, is the same in both. When stowed away, the mast was perhaps laid on the stanchions, which are provided with cross bars, placed fore and aft, and fastened at the bottom of the vessel to beams having the ends, like the block at the step of the mast, cut into the shape of a fish's tail. Moreover, when the mast was down, the said cross-bars may also have had to support the yard, a very heavy spar compared to the size of the vessel, which, as still usual in many coasting craft from the northern districts of Norway, certainly carried only one sail (a large square sail). In this manner her mast and yard could be stowed away without incommoding the crew. Fragments only remaining of the mast, its entire length cannot be accurately determined.

The oars, of which several have been preserved, are about 20 feet long, the length varying slightly according as they had to be served amidships or at the extreme ends of the vessel. They have been plied through holes bored in the third strake from the top, and provided on the inside with sliding covers, which, when the oars were unshipped, could be pushed over the holes to prevent the sea from entering. The oars have been passed through the holes from inboard, and hence there is a notch cut in the edge of the hole for the blade. No trace can be discovered of thwarts or seats for the oarsmen.

From the number of holes the vessel is shown to have carried 16 oars on either side. As many as 32 men would thus have been required to serve the oars alone, and the ship must therefore have had a complement of not less than 40 hands, even with only one man to each oar and the oarsmen not rowing by turns.

There was no deck, only loose boards resting on shoulders cut in the frames. These boards, particularly in the midship section, are placed

at some distance from the bottom, thus affording space for stowing away beneath them a good many of the articles belonging to the ship or to the crew, but no accommodation for the men. To provide some protection against the weather it was customary in the ships of that period to stretch a tent-cloth above some part of the vessel, under which most of the hands could find shelter. In the ship discovered at Gokstad were found the four supports of such a tent, together with fragments of the cloth and the cords. The supports are heavy boards, 11 feet 8 inches (3.5 meters) in length, finely carved at the upper extremities to represent the head of some animal, and in part painted. They had been placed obliquely, so as to form two crutches, one at each end of the tent, with the carved heads projecting, and connected together by the pole, or rather transverse bar of the tent, which thus formed a gable-ended roof, extending fore and aft from the pole to the rail of the ship. The tent-cloth is made of a rather fine woolen texture, white, with broad red stripes sewed on; the cords for fastening it are hemp. The pieces of ship's rope, of which a good many were found, are all made of bast.

The rudder is hung by a rope a little forward of the stern-post, on the right-hand side, as usual in all vessels of the Viking period, and long after—down, indeed, to the XIV century (hence "starboard"). The method of fastening and guiding this ancient style of side-rudder was not satisfactorily known previous to the discovery of the Gokstad ship.

Of the numerous articles of antiquarian value found in or about the ship, more or less perfectly preserved, the following deserve special mention:

a. Fragments of three oak boats that had been broken up previous to being deposited in the vessel, and no part of which, with the exception of the keel, can now be put together. Like the ship, they were clinker-built, but instead of holes for the oars they have rowlocks of a peculiar form, fastened to the gunwale. Two of the boats have certainly carried a mast. Their size has been comparatively considerable, the keel of the largest boat measuring 22 feet 4 inches in length, and that of the smallest 14 feet. Several of the oars belonging to the boats are preserved; they exactly resemble those used for rowing the ship.

b. The stock of the anchor; being of iron, it had almost corroded away.

c. A landing-stage, or gangway, 25 feet long, but only 20 inches wide. It has the upper surface transversely ribbed, to give a secure footing.

d. Fragments of sleeping berths, at least four. These berths, a couple of which have been restored, are of much the same shape as the bedsteads now in use among the Norwegian peasantry. They are very low and put together so as to be readily taken to pieces and stowed away.

e. Parts of a wooden chair, finely carved, that would appear to have been the high seat of the chieftain or commander of the vessel. The side pieces—in an excellent state of preservation—are modeled at the top to represent the heads of animals, in precisely the same style as the upper end of the tent-supports.

f. A great variety of kitchen utensils, among which were a very large and massive copper kettle, together with the iron chain, gracefully wrought, for suspending it over the fire; bits of a smaller kettle, of iron, and of the chain belonging to it; numerous tubs and buckets of different sizes; wooden plates; several small, finely carved wooden drinking-cups, with handles; and many other articles. No trace of a fireplace can be discovered in the ship, nor would it, indeed, have been easy to provide one in an open vessel of this kind. Hence, the cooking utensils were only of service while coasting, when a harbor could at any time almost be gained; and in those days a ship kept near the shore whenever possible.[1]

Something remains to be said of the tomb in which this vessel was discovered, and to which we are indebted for her preservation.

The barrow was very large, of the usual circular form. The ship had been interred in the middle, on her keel, decorated with shields hung close together along the rail on both sides of the vessel. This was a general custom in Norway till late in the Middle Ages, when dressing a ship on festive occasions, and corresponded to the decking out of a vessel with flags in our times. A few of these shields have been successfully restored and placed in position. They are of wood, circular in shape, 36 inches in diameter, but extremely thin, with a boos of iron in the center, and plated at the rim with narrow strip of the same metal.

A large grave-chamber of wood is built in the middle of the ship from the mast towards the stern. It has the form of a gable-roof, the sides consisting of round logs, and the gable-ends of planks placed on end. In this chamber the remains of the dead were deposited, unburnt, and no doubt on a bed, fragments of a bedstead having been found in the chamber.

Unfortunately, this ship-tomb had been visited by grave-robbers, in all probability during the pagan era. They have dug into the mound on the port side, and gained access through a large opening which they cut in the ship's side and the wall of the grave-chamber. This accounts for the fact, that the bones of the body had nearly all disappeared; that in the chamber there were but few articles of antiquarian value compared with what it might reasonably have been expected to contain; and in particular, that no implement of war was to be found. Mean-

[1] Nicolaysen, Langskibet, etc., p. 23, says: "The cooking could only be done on land, which is presupposed in the municipal law of Bergen (1276), where it is enacted that the mate shall, whensoever the ship lies at anchor in harbor, cause the crew to be put on shore and backward once a day, but the cook thrice, once to take in water and twice to prepare food."

while, the miscellaneous character of that still remaining gives reason to infer that a manifold collection of weapons, ornaments, and utensils had originally been deposited. Thus, several iron fish-hooks and a turned draughtsman of horn were found in the grave-chamber. The most remarkable of the remaining articles are two ornamental mountings for belts or straps, one of gilded bronze, beautifully executed in a peculiar and characteristic style, and the other of lead. Of wearing apparel belonging to the deceased a few small fragments were found, some of gold brocade.

A great number of animals must have been sacrificed on the occasion of this burial. The bones of at least 12 horses and 6 dogs, as also the bones and feathers of a pea-fowl, were collected from different parts of the mound.

The various articles of antiquarian value found in the barrow, together with the style of ornamentation in the carving of different parts of the ship, sufficiently attest the correctness of the inference concerning her antiquity which the mere fact of entombing a vessel in itself entitles us to draw, namely, that she belongs to the period extending from the year 800 to 1050 after Christ.

Mr. Nicolaysen in his description of this boat says:[1] "That there may yet be found in many parts of our country, near its sea coast, tumuli containing ships in tolerable preservation, is by no means improbable; though this can only occur when the under-ground is blue clay; but any larger or better appointed vessel can scarcely be found. Still, it is not impossible that one may yet be brought to light whose exceptionally careful conservation will enable us to elucidate that which in the Gokstad ship is still wanting, and specially show the height of the posts and the form and fixing of the oarsmen's benches in our ancient vessels. Certain, nevertheless, it is that we shall not disinter any craft which, in respect of model and workmanship, will outrival that of Gokstad. For, in the opinion of experts, this must be deemed a masterpiece of its kind, not to be surpassed by aught which the shipbuilding craft of the present age could produce. Doubtless, in the ratio of our present ideas, this is rather a boat than a ship; nevertheless, in its symmetrical proportions and the eminent beauty of its lines is exhibited a perfection never since attained, until, after a much later but long and dreary period of clumsy unshapeliness, it was once more revived in the clipper-built craft of our own country."

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[1] Nicolaysen, Langskibet, etc., p. 71.